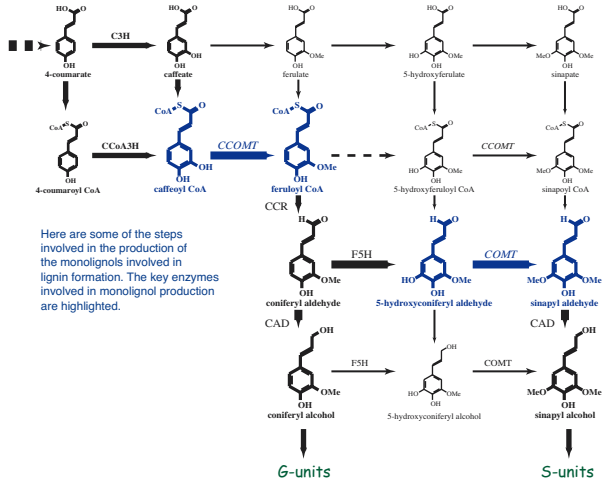
Altering Lignin in Plants

The lignin molecule is complex and made from different building blocks called monolignols. These components are chemically connected in a number of ways. The production of these monolignols involves many biochemical steps (enzymes). Plants that contain deficiencies in one or more of the enzymes can produce dramatically altered lignins. As a result, these plants are very useful to our research on lignins and forage digestibility.

Biochemical steps involved in the production of monolignols



Here are some of the steps involved in the production of the monolignols involved in lignin formation. The key enzymes involved in monolignol production are highlighted.

G-units and S-units result from the many biochemical steps in the production of monolignols. These units represent the most common monolignols produced and incorporated into the growing lignin molecule in the cell wall.

A bm corn plant next to a normal growing plant. Notice the difference in plant height.

Some lignin mutants occur naturally. Examples are the brown-midrib (bm) mutants of corn. One of the corn mutants has a deficiency in the COMT enzyme. The activity of this enzyme is greatly reduced inhibiting the production of monolignols forming the lignin molecule.

Laboratory derived transgenic alfalfa have a deficiency in the COMT enzyme just like the bm mutant corn. Other transgenic alfalfa plants have greatly reduced CCOMT enzyme activity.

So...

What happens to lignin formation in a plant when restrictions or obstacles (natural or imposed) are placed on one of these enzymes?

RESULTS

COMT deficient plants

- ↓ lignin content (with NEW monolignols discovered in the lignin!!)
- ↑ digestibility
- alfalfa normal plant growth
  corn stunted growth

CCOMT deficient plants

- ↓ lignin content (a shift in the production of NORMAL monolignols)
- normal plant growth

The next step in these investigations will be to determine the benefits (realized gain) to dairy production from a lower/altered lignin forage!!